throughout the universe, because it is based on invariant aqueous carbon chemistry—primarily the universal reduction potentials of carbon groups.

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ASTROPHYSICS

The Nearby Stars (NStars) Project

Dana E. Backman

NStars is a project based at Ames to produce a comprehensive Web-accessible database on stars closer than 80 light years to Earth and to promote further observations of those stars by the astronomical community. This effort supports present and future NASA Origins missions such as the Space Infrared Telescope Facility (SIRTF), Stratospheric Observatory for Infrared Astronomy (SOFIA), and the Terrestrial Planet Finder (TPF). For example, TPF is planned as an array of infrared space telescopes capable of detecting Earth-like planets orbiting our nearest neighbor stars. This task is so technically difficult that TPF will not be able to survey all stars within its distance range during a reasonable mission lifetime. NStars is intended to help select a subset of target stars for TPF that have the best chance of harboring an Earth-like planet.

During FY99, a preliminary version of the database was demonstrated to participants in a special Ames workshop on nearby stars. Capabilities to help users examine data over the Web and define subset lists of interesting stars for further investigation were demonstrated. A substantial number of comments from the researchers attending the workshop were collected for further improvement of the database and its user interfaces.

The Nearby Stars workshop was held over three days in June 1999, organized and hosted by the NStars project scientists. The format involved a small number of invited speakers plus poster presentations. The invited talks addressed major topics in astrophysical research on nearby stars. The invited talks, posters, and notes from discussion sessions will be published as a NASA conference publication in 2000.

NStars project scientist Dana Backman addressed the SIRTF Science Working Group in March 1999 about the NStars project and its support for definition of SIRTF observing programs. Backman also gave a talk at the SOFIA Star Formation workshop in Santa Cruz, California, in July 1999 on possible SOFIA key projects investigating nearby stars.

Five undergraduate students (Avi Mandell, Aaron Burgman, Emma Roberts, Mike Connelley, and Pete Nothstein) worked as research assistants during 1999 on projects connected to NStars. Their projects included: (a) comparison of techniques for determining ages of stars; (b) surveys for variability of solar-type stars using a robotic telescope; and (c) compilation of archived astronomical data to prepare for SIRTF observing programs. Software, database, and Web page development for NStars involved part-time employment of Symtech personnel Sarah West, Eric Vacin, Mick Storm, and Peter Mariani.

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Observations of Extrasolar Planets

Tim Castellano

In the last several years, more than 30 planets have been discovered orbiting other stars. All discoveries to date have been by the radial velocity method whereby extremely small variations in the speed of the star relative to Earth are used to infer the presence of an unseen orbiting companion. More than 20% of the planets discovered orbit their parent stars for periods of less than a week. For these short-period orbits, 10% will be oriented such that the planet will periodically pass in front of the star as seen from Earth. An alternate method of detecting extrasolar planets employing high-precision measurements of the brightness of the stars can confirm the existence of the planet and obtain its mass and radius. This technique was convincingly demonstrated when the

first-ever measurement of the dimming of a star (HD 209458) because of the passage of an orbiting planet occurred in late 1999. This "extrasolar planetary transit" was discovered independently by two groups and widely reported in the news media.

Soon after the announcement, Ames conducted an archival search of the brightness data of the star HD 209458. The data, collected by the European Hipparcos satellite between 1989 and 1992, revealed a photometric dimming consistent with the observed radial-velocity measurements and ground-based transit observations. The long baseline in time between the Hipparcos measurements and the present allowed a precise determination of the orbital period of the planet. These results will be published in the *Astrophysical Journal Letters*. The successful confirmation of an extrasolar planetary transit in the Hipparcos data suggests that it may be possible to discover more extrasolar planets around sun-like stars using data from the Hipparcos satellite or NASA's planned Full Sky Astrometric Explorer (FAME) satellite.

A novel method for obtaining high-precision photometric measurements of bright stars using a spot filter and charge coupled device detectors on ground-based telescopes has been developed. A demonstration of the technique was performed on the sun-like star HD 187123 in the fall of 1999. Athough no transit of an extrasolar planet was seen, the required precision was achieved, as shown in figure 1. Additional observations were made of the stars bearing extrasolar planets HD 217107, 51 Pegasi, Upsilon Andromedae, and Tau Bootes, without result.

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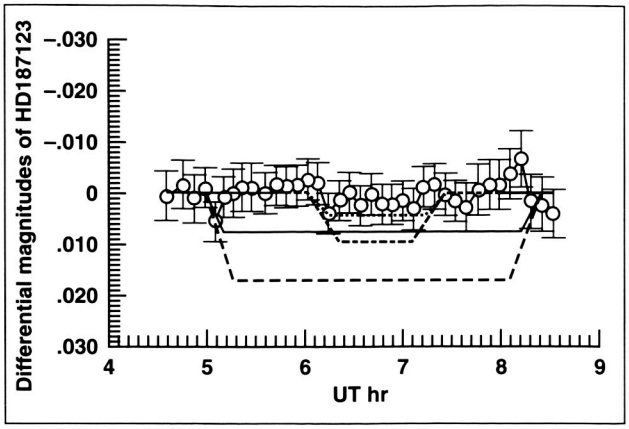

Fig. 1. A sample of data for the star HD 187123 compared to a range of simulated possible transit signals produced by Jupiter-like planets passing in front of a solar-like star.

Composition of Dust Along the Line of Sight Toward the Galactic Center

Jean Chiar, Alexander Tielens, Douglas Whittet

The composition of dust and ice along the line of sight to the galactic center (GC) has been investigated through analysis of midinfrared spectra (2-13 microns) from the Short Wavelength Spectrometer on the Infrared Space Observatory (ISO). The path to the GC samples both diffuse interstellar matter and dense molecular cloud environments by performing a phenomenological comparison with well-studied sightlines known to sample these distinct environments. We have been able to separate spectral absorption features arising in these components toward the GC. Dust absorption features along the lines of sight toward Sagittarius A* (Sgr A*) and the Quintuplet sources (GCS3 and GCS4) are the primary targets in this endeavor. Molecular cloud material is unevenly distributed across the GC. Measurements of absorption features due to abundant solid-state species, such as water/ice and carbon dioxide, reveal that there is more molecular cloud material along the line of sight toward Sgr A* than toward the Quintuplet sources. The Sgr A* sightline has a rich, solid-state infrared